

Sparx Science

A Level Transition Booklet
Answers



Physics

1. Handling data

- 1.1 a) hertz
1.1 b) newton
1.1 c) joule
1.1 d) watt
1.1 e) pascal
1.1 f) coulomb
1.1 g) volt
1.1 h) ohm
1.1 i) tesla

1.2

Unit name	Abbreviation
Nanojoule	μJ
Microjoule	GJ
Millijoule	kJ
Gigajoule	nJ
Kilojoule	mJ
Megajoule	MJ

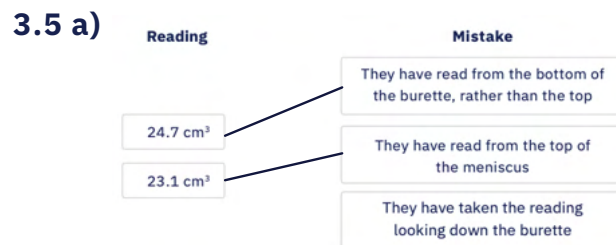
- 1.3 1 nW, 1 μW , 1 mW, 1 kW, 1 MW, 1 GW
1.4 a) 15 000 000 W
1.4 b) 390,000 mW
1.5 a) 9,800,000,000 (or 9.8×10^9) nPa
1.5 b) 0.000 017 4 MPa

1.6

True	False
✓	
✓	
	✓

- 2.1 800
2.2 0.6
2.3 0.2
2.4 0.04
2.5 Monday and Friday
2.6 a) 3 significant figures
2.6 b) This is the same number of significant figures as the original data.

- 3.1 45 cm^3
3.2 56°C
3.3 15 V
3.4 1.6 mA



- 3.5 b) 23.3 cm^3
4.1 The smallest change it can detect
4.2 It has a higher resolution
It is harder to misread the temperature
4.3 1 cm^3
4.4 0.01 g
4.5 0.05 V
5.1 An error that has a predictable effect on every measurement.
5.2 An error that cannot be predicted.

5.3

Systematic error	Random error
	✓
	✓
✓	

5.4

Systematic	Random
✓	
	✓
✓	
	✓

5.5 a)

Random	Systematic
	✓
	✓
✓	

5.5 b) Random error

6.1

True	False
✓	
	✓
	✓

6.2 The range of values is very small

6.3 Random error

6.4 The data logger has a higher resolution.

The students are less likely to make a mistake when reading from a digital display, compared to a scale.

6.5 The true wavelength could be 3 cm above or below the mean

6.6 a) Student A

6.6 b) Student A's results are more varied/have a larger range.

6.7 Between 69 cm and 79 cm

6.8 They could play back/pause/slow down the video to make it easier to judge the highest point reached when the ball bounced.

2. Mechanics and materials

1.1

Vector quantity	Scalar quantity
✓	
	✓
	✓
	✓
✓	
✓	

1.2 a) 20 m

1.2 b) 35 m

1.2 c) 5 m

1.3 30 km

1.4 Distance is a scalar quantity and displacement is a vector.

Since the car does not travel in a straight line, the direction changes which causes the displacement to change.

2.1 4800 m

2.2 17 m/s

2.3 2.0×10^{10} s

2.4 You should measure the circumference of the circle that the cups turn through. You should then count the number of times the cups rotate in a given time and multiply this by the number of rotations.

You can then calculate the speed using the equation speed = distance/time.

2.5 The force due to gravity causes the satellite to accelerate towards Earth. Acceleration causes a change in direction. If direction changes, velocity changes.

2.6

Section	Description
A to B	The car is stationary
B to C	The car is travelling at a constant speed, less than 40 km/h
C to D	The car is accelerating
D to E	The car is moving at 60 km/h
E to F	The car is travelling at the fastest speed

3.1 1.75 m/s^2

3.2 -2.8 m/s^2

3.3 6 s

3.4 164 m/s

3.5 24 m/s

4.1 33 000 m

4.2 2400 m

4.3

Distance-time graph



Velocity-time graph



4.4 0.6 m/s²

4.5

Accelerating	Decelerating	Constant velocity
		✓
	✓	
✓		
✓		
		✓

5.1 7.9 J

5.2 20 m/s

5.3 a) 1.9 J

5.3 b) 1.9 J

5.4 5.88 J

5.5 3.7 N/kg

5.6 0.46 m

6.1 energy transferred.

6.2 3360 Nm

6.3 Work is done by friction between the brakes and the wheels. The kinetic energy store decreases and the thermal energy store of the brakes increases.

7.1 Resultant force

7.2 The magnitude of the force

7.3

Possible value for A		
10 N	20 N	40 N
✓		
		✓
	✓	

7.4 a) horizontal component: 125 N
vertical component: 100 N

7.4 b) 6.4 cm

8.1 If the resultant force is zero, an object continues to move at the same velocity.

8.2 Newton's Second Law

8.3 a) Object A

8.3 b) Acceleration is inversely proportional to mass.

8.4 5600 N

8.5 When two objects interact, they exert equal and opposite forces on each other.

8.6 a) 490 N

8.6 b) Size: 490 N

Direction: Upward

9.1 260 kg m/s

9.2 3.28 kg

9.3 258.75 m/s

9.4 a) 0 kg m/s

9.4 b) It increases

9.5 During a collision, momentum is conserved. Since the momentum of the pin increases, the momentum of the ball must decrease.

9.6 9.3 m/s

10.1

Type of deformation	
Elastic	Inelastic
	✓
✓	
	✓

10.2 They could remove the weight and see if the spring returns to its original length and shape.

10.3 The line goes through the origin

The line is straight

10.4 a) 0.25 m

10.4 b) 20 N

10.5 a) D

10.5 b) D

10.6

Spring			
A	B	C	D
✓	✓		
✓			
			✓

3. Waves

1.1 a) Transverse

1.1 b) Longitudinal

1.2 A: rarefaction

B: compression

1.3 a) Transverse wave

1.3 b) At right angles to the wave direction.

1.3 c) In the same direction/parallel to the wave direction.

1.4 In a transverse wave, the particles vibrate perpendicular to the direction of wave travel.

In a longitudinal wave, the particles vibrate parallel to the direction of wave travel.

2.1 a) Amplitude

2.1 b) Wavelength

2.2 a) B

2.2 b) B

2.3 a) Longitudinal wave

2.3 b) B

2.4 a) B and D

2.4 b) A and B

2.5 The student should count how many ripples pass a fixed point in a set time using a stopwatch. They should divide the number of ripples by the time taken to find the frequency.

2.6 a) B

2.6 b) The particles vibrate backwards and forwards, parallel to the direction of the energy transfer.

3.1 1400 m/s

3.2 32 m

3.3 a) 1 m

3.3 b) 0.06 Hz

3.4 They should measure the length of the rod and multiply it by two.

4.1

Description	Name
Waves bounce off the surface of a material.	Absorption
Waves pass through a material.	Reflection
Wave energy is transferred to a material	Transmission
	Emission

4.2 a) A: incident ray

B: reflected ray

4.2 b) C: angle of incidence

D: angle of reflection

4.3 a) 60°

4.3 b) 60°

4.4 B

4.5 a) A: angle of incidence

B: angle of refraction

4.5 b) Normal

4.5 c) Protractor

4.6

Moving to a less dense medium	Moving to a denser medium
✓	
	✓
	✓

- 4.7** The wave speed will decrease.
The wavelength will decrease.
The wave will change direction.
- 4.8** A: incident ray
B: refracted ray
C: reflected ray
- 4.9** As the angle of incidence increases, the angle of refraction increases. The relationship is not linear.

4. Electricity and circuits

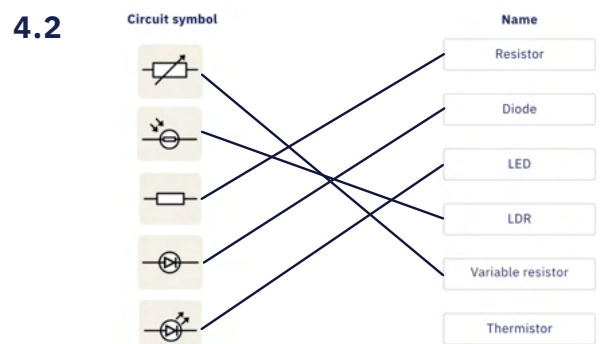
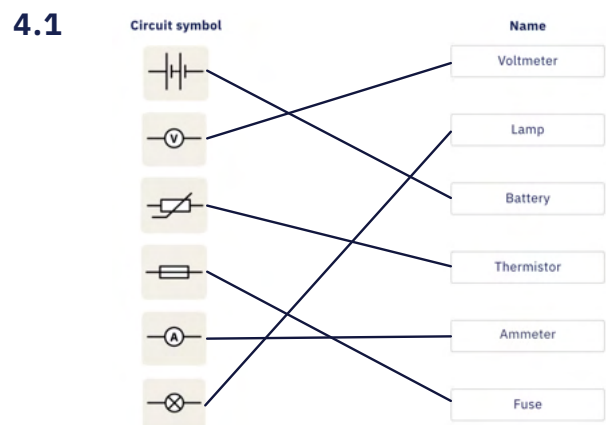
- 1.1** A potential difference
A closed circuit
- 1.2** Current is the flow of electrical charge.
- 1.3** 1296 C
- 1.4** 12 A
- 1.5** 300 s
- 1.6 a)** From positive to negative
- 1.6 b)** From negative to positive
- 2.1** energy
- 2.2** 22500000000 J (22.5 GJ)
- 2.3** 5 V
- 3.1** resistance
- 3.2** 4.2 A
- 3.3 a)** Fixed resistor
- 3.3 b)** The gradient would be less steep
The line would not be straight
- 3.4** A: Fixed resistor
B: Filament lamp
C: Diode
- 3.5** 400 Ω
- 3.6** 4.2 V
- 3.7 a)** 4 mA
- 3.7 b)** 65 J

- 3.8** The lamp is initially cold, so it will have a lower resistance. This low resistance means it will have a higher current, making it more likely to break.
- 3.9** As the temperature of the filament in the lamp increases, the metal ions vibrate faster and so electrons collide more frequently with the ions.

3.10 a) thermistor

3.10 b) It decreases

3.11 C



4.3 a) series

4.3 b) It takes one route through all 3 bulbs

4.3 c) parallel

4.3 d) It can take a different route to each bulb

4.4

How are the devices connected?	
In series	In parallel
✓	
	✓
	✓

4.5 C

5.1 9 V

5.2 1 V

5.3 80 Ω

5.4 a) V_2

5.4 b) 4 V

5.5 a) 1.5 V

5.5 b) 1.5 V

5.6 7 Ω

5.7 9 V

5.8 a) Circuit A

5.8 b) There are multiple paths for the current to take.

5.9 The strain gauge will stretch and the resistance will increase, which will cause the current in the circuit to decrease. This shows as a decrease in the reading on the ammeter.

6.1 0.0032 A (3.2 mA)

6.2 0.006 A (6 mA)

6.3 a) 30 C

6.3 b) 60 C

6.3 c) 60 C

6.4 a) 2 V

6.4 b) 20 Ω

6.5 a) It will decrease

6.5 b) It will decrease

6.6 25.6 k Ω

6.7

Reading		
Increases	Decreases	No change
✓		
	✓	

7.1 3024 J

7.2 14 V

7.3 1300 W

7.4 8.3 A

7.5 112 Ω

7.6 75 W

7.7 8.64 A

7.8 3.83 Ω

5. Thermodynamics

1.1 a) Separation of the particles

1.1 b) Solid

1.2 The particles moving faster

1.3 The sum of the potential energies and the kinetic energies of all the particles in a substance.

1.4 The kinetic energy of the particles

1.5 Gas A molecules move more slowly than gas B

Molecules in both gases have the same kinetic energy

2.1 a) 1820 J

2.1 b) 5460 J

2.2 Block X has a lower specific heat capacity than block Y.

2.3 500 J/kg $^{\circ}\text{C}$

2.4 95 $^{\circ}\text{C}$

2.5 a) Overestimate

2.5 b) Energy is lost to the surroundings during heating.

2.6 435 J/kg $^{\circ}\text{C}$

2.7 a) 22 $^{\circ}\text{C}$

2.7 b) The heater will take time to heat up so it will not immediately start transferring energy to the block.

3.1 Specific heat capacity is associated with changes in temperature, whereas specific latent heat is associated with changes of state.

3.2 X has twice the specific latent heat of Y

3.3 6000000 J (6 MJ)

3.4 22400 J/kg

3.5 0.018 kg

4.1 a) A

4.1 b) C

4.1 c) E

4.1 d) B, D

4.2 a) melting
boiling

4.2 b) water

4.3 D, A, C, B

5.1

Effect		
Increases	Decreases	Stays constant
✓		
✓		
✓		

5.2 Heating the gas increases the temperature. Temperature is proportional to the kinetic energy of the particles. So, increasing the temperature increases the kinetic energy and the speed of the particles.

5.3

Effect		
Increases	Decreases	Stays constant
	✓	
		✓
	✓	
		✓

5.4 As the temperature increases, the gas particles gain kinetic energy and move faster. They collide with the tyre walls more frequently and with greater force. This increases the pressure inside the tyres.

6. Particle Physics

1.1 electron, proton, neutron

1.2

Charge				
-2	-1	0	+1	+2
	✓			
		✓		
			✓	

1.3 E, F

1.4

Particles that contribute to this number		
Electrons	Protons	Neutrons
	✓	
	✓	✓

1.5 a) 9

1.5 b) 10

1.6 Isotopes are atoms that contain the same number of protons but a different number of neutrons in the nucleus.

1.7 a) 6

1.7 b) 7

1.7 c) 6

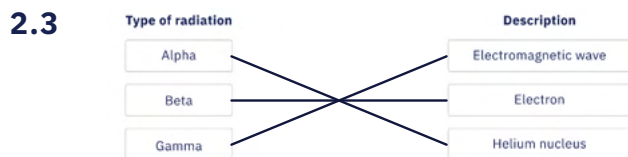
1.8 The number of charged subatomic particles (protons and electrons) is the same between isotopes.

1.9 C, D, A, B

1.10 The atom becomes positively charged, because it now has two more protons than electrons.

2.1 The radiation can cause atoms to lose electrons

2.2 The nucleus



2.4 a) protons: 2
electrons: 0
neutrons: 2

2.4 b) +2

2.5 Gamma waves transfer energy away from the nucleus and so reduce the energy of the unstable nucleus.

2.6 gamma radiation, beta radiation, alpha radiation

2.7

The radiation can be blocked by...		
Thick paper	Thick aluminium	Thick lead
✓	✓	✓
	✓	✓
		✓

2.8 Beta radiation is more penetrating than alpha radiation, so could irradiate someone walking close to the detector.

2.9 Alpha particles have more charge than beta.

3.1

Increases	Decreases	Stays the same
✓	✓	

3.2 a) beta

3.2 b) 86

3.3 a) 91

3.3 b) 234

3.4 a) The atomic numbers on each side of the equation are not equal

3.4 b) beta

4.1 becquerel, Bq

4.2 72 000 nuclei

4.3 a) Accept any answer between 7.1×10^6 and 7.4×10^6 Bq

4.3 b) Accept any answer between 8.8 and 9.2 minutes

4.4 a) C

4.4 b) The atoms of C decay at the fastest rate.

4.5 The half-life is the time it takes for half the radioactive nuclei in a sample to decay.

4.6 a) 440 years

4.6 b) 440 years

4.7 12.5 g

4.8 5

4.9 You cannot predict which dice will land on a one and when a given dice will land on a one.

4.10 a) 1300 million years

4.10 b) Accept any answer between 2550 and 2650 million years

7. Fields

1.1 a) south

1.1 b) They repel

1.2 a) R

1.2 b) Q

1.3 How close the field lines are to each other

1.4 D

2.1 Cobalt, Iron, Nickel

2.2 a) Permanent

2.2 b) Induced

2.3 A, C, F

2.4 a) south

2.4 b) They will attract each other

2.5

Type of magnet		
Induced	Permanent	Not magnetised
	✓	
✓		
		✓

3.1 Increase the current in the wire

3.2 a) Anticlockwise

3.2 b) It decreases

3.3 C

3.4 a) Iron

3.4 b) Non-permanent

3.5

Effect on strength of magnet		
Increase	Decrease	No effect
	✓	
✓		
	✓	

3.6 The iron can be easily magnetised (and demagnetised).

3.7 a) Left arrow

3.7 b) Right arrow

3.7 c) Left arrow

3.8 a) D

3.8 b) Ignore the result and repeat the measurement.

3.8 c) Repeat the experiment

4.1 first finger: direction of the magnetic field
second finger: direction of the current
thumb: direction of the force

4.2 left

4.3 a) From X to Y

4.3 b) Increasing the current in the wire

4.4 O, P

4.5 a) Current flows through the wire, from B to A, causing a magnetic field around the wire. This field interacts with the field of the permanent magnets causing a force on the wire, moving it up.

4.5 b) The direction of current in the wire will oscillate due to the AC power supply, this means the force will also switch direction. Therefore the wire will also oscillate.

4.6 0.25 T

4.7 4.4 m